Eur J Vasc Endovasc Surg 15, 239–243 (1998)

# Sympathetic Skin Response and Patient Satisfaction on Long-term Follow-up after Thoracoscopic Sympathectomy for Hyperhidrosis

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***Objectives:*** *To determine effect of sympathectomy for hyperhidrosis on sympathetic skin response (SSR) during long-term follow-up. Patient satisfaction was assessed and surgical complications noted.*
***Design:*** *Prospective, Open, Non-randomised study.*
***Materials and Methods:*** *Patients who had undergone bilateral thoracoscopic sympathectomy for hyperhidrosis underwent postoperative assessment of SSRs. A 15 mA stimulus was applied over the median nerve contralateral to the sympathectomy and evoked electrodermal activity was recorded from the sympathectomised palm using a Dantec Counterpoint Mk 2. Patient satisfaction with surgery was assessed by questionaire and visual analogue score (0–1.0).*
***Results:*** *Of 26 patients, 21 were female. Mean (range) age was 23 (9–36) years. Mean (range) follow up was 39 (4–138) months. 12% of cases had residual or recurrent symptoms. Median (range) patient satisfaction was 0.83 (0.06–1.0). In 7/52 palms recurrent SSRs were not detected. Repeated measures analysis of variance found amplitude of SSR to be of low significance with respect to time since surgery ($F=0.48$; $p=0.49$) and incidence of compensatory sweating ($F=2.38$; $p=0.14$).*
***Conclusion:*** *Thoracoscopic sympathectomy for hyperhidrosis is an effective procedure. Following sympathectomy SSRs are not permanently abolished, but return of SSRs does not correspond with symptom recurrence. As such, SSRs are a poor tool for objective assessment of long-term outcome following sympathectomy.*

*Key words: Sympathectomy; Thoracoscopy; Hyperhidrosis.*

## Introduction

Primary hyperhidrosis has an estimated incidence of 0.6–1.0% and presents most commonly in adolescents.[1] It is a pathological condition of sweating in excess of that required for thermoregulation or psychological response. Aetiology is unknown. Sweating usually affects the palms or axillae (43%) but may also affect other areas of the body.[2–4] Primary palmar hyperhidrosis has an incidence of 0.15–0.25%.[1]

Hyperhidrosis is a distressing condition that can impair quality of life causing social, psychological, educational and occupational problems.[5] In some professions the condition may be a handicap, while in others, such as electricians, excessive palmar sweating may actually be dangerous.[6]

Thoracoscopic sympathectomy, first described by Hughes in 1942[7] and later advanced by Kux,[8] has become established as an effective treatment for palmar and axillary hyperhidrosis with high patient satisfaction and low morbidity.[9–13] However, potential complications can occur; these include: haemo-/pneumothorax, Horner's syndrome, lymphatic damage, acute and chronic pain, compensatory sweating and recurrence of symptoms.[14] Despite these, in carefully selected patients sympathectomy is the gold standard against which other treatments for hyperhidrosis are now judged.[5] The endoscopic approach to the thoracic sympathetic chain reduces postoperative morbidity, operation time and hospital stay.[15–18] Open operation is now rarely performed in many centres that have the expertise to perform thoracoscopic sympathectomy.[19,20]

Other operative techniques for axillary hyperhidrosis now seldom practised include: excision of an ellipse of hair-bearing skin,[21] excision of sweat glands,[22] subcutaneous curettage[23] and cryosurgery.[24]

Medical therapeutic measures are unsuccessful at controlling symptoms in approximately 30% of patients[17] and are not without complications.[25]

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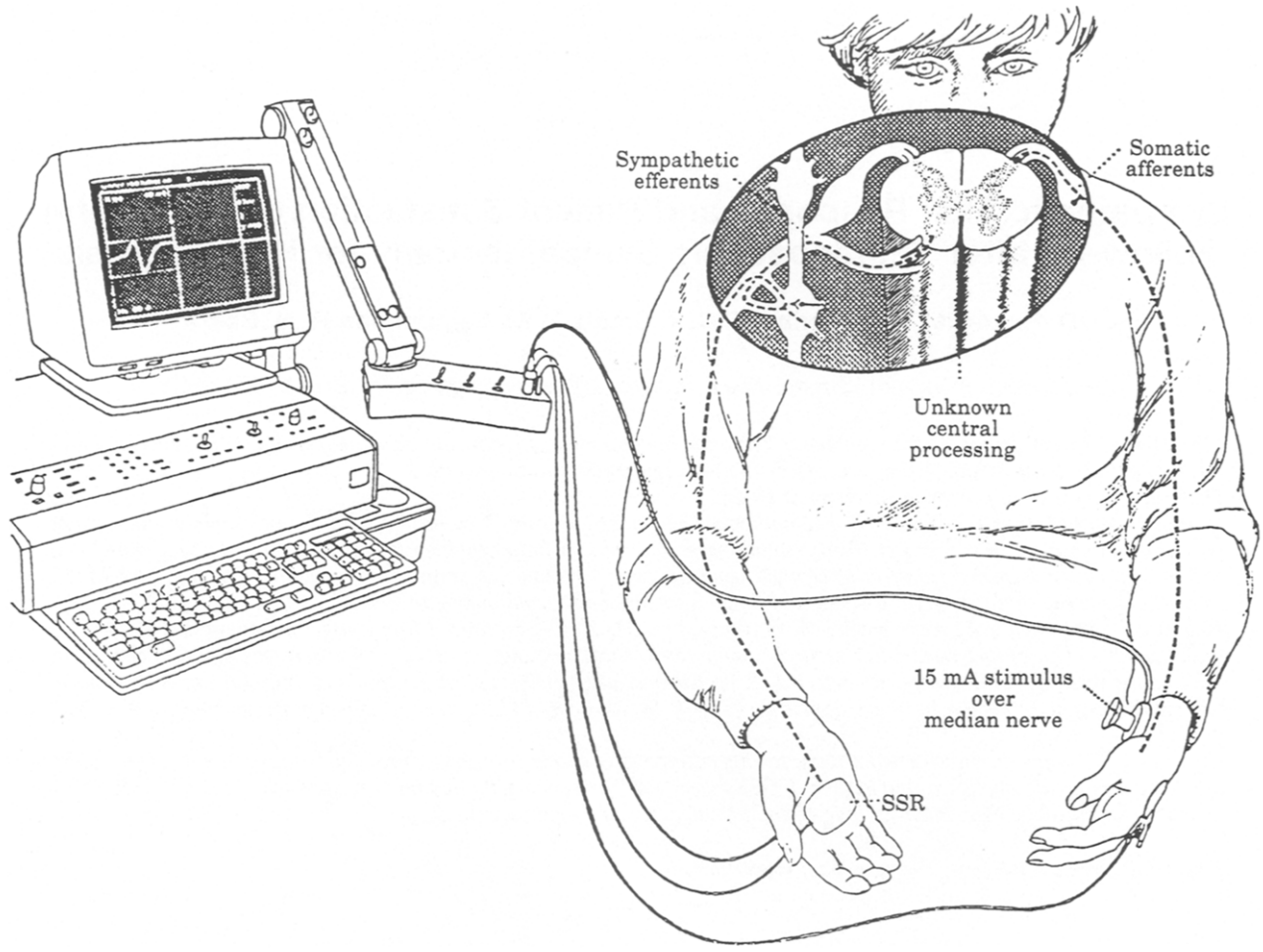


**Fig. 1.** Diagramatic representation of the pathways involved in the sympathetic skin response and equipment used to measure SSR.

Non-surgical treatments have included anticholinergic drugs, antiperspirant sprays, paints and pastes, astringents, iontophoresis and local radiotherapy.[26]

*Assessment of sympathetic function*

The measurement of electrodermal activity in the form of sympathetic skin responses (SSRs) has been proposed as an investigation for sympathetic nerve function.[27,28] SSRs involve complex neural pathways with sensory afferents, unknown central circuits and sympathetic efferents[29] and are evoked endosomatic electrodermal activities[30,31] (Figure 1).

Recently, abnormal SSRs have been demonstrated in patients with hyperhidrosis (Figure 2a and b), and it has been suggested that hyperhidrosis is due not solely to sympathetic overactivity but also to regulatory dysfunction.[32] Abolition of SSRs has been shown to occur immediately following thoracoscopic sympathectomy (Figure 2c) and use of SSRs to provide objective assessment of outcome following surgery has been advocated.[33]

The aim of this study was to measure SSRs on long-term follow-up of patients who have undergone thoracoscopic sympathectomy for primary hyperhidrosis and to determine any correlation between SSR, clinical outcome and time since surgery.

## Patients and Methods

Patients who had undergone thoracoscopic sympathectomy for the treatment of primary hyperhidrosis

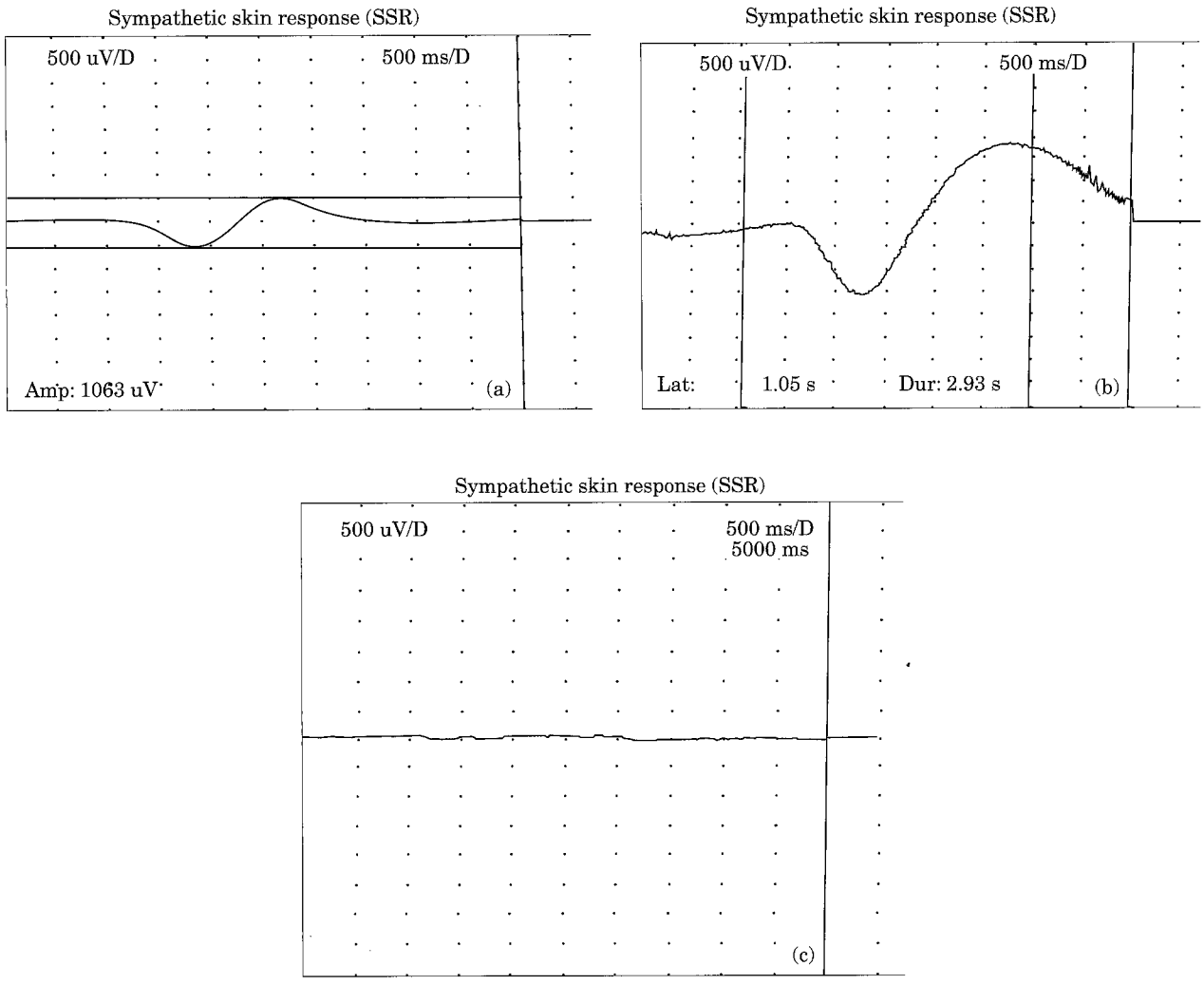


**Fig. 2.** (a) Normal SSR. (b) Abnormal SSR. Normal waveform but large amplitude. (c) Absent SSR.

since 1985 were identified from a prospective database, the Bristol Infirmary Patient Audit System (BIPAS). Patients were contacted by letter asking them to attend for a follow-up appointment. If no response was obtained a second letter was sent.

Data was collected on demographic details, operation, complications and postoperative hospital stay. At follow-up patient satisfaction was measured using a visual analogue score and questionnaire. Patients were asked to grade their pre- and postoperative sweating as none, mild, moderate or severe. Outcome of surgery was judged successful if symptoms of excessive sweating were abolished.

SSRs were measured using a Dantec Counterpoint Mk 2. The active electrode (Nicolet disposable silver/silver chloride) was placed on the palm of the hand being assessed and a self-adhesive reference electrode (Medelec) placed on the dorsum of the same hand. A ground electrode (Medelec) was placed on the dorsum of the contralateral hand and stimulation applied over the median nerve on this side (Figure 1). A stimulating impulse of 15 mA was applied for 0.2 ms. The presence or absence of SSRs in each limb was noted. Recorded SSRs were analysed with regard to amplitude. The association between amplitude of SSR and time elapsed since surgery was investigated using repeated measures analysis of variance (right and left palms) with time as a covariate. The relationship between amplitude of SSR and incidence of compensatory sweating was investigated using repeated measures analysis of variance and covariance (using BMDP programme P2V). Age and sex were investigated as covariates.

## Results

Thirty-six patients underwent thoracoscopic sympathectomy for hyperhidrosis between 1985 and 1996

**Table 1. Early and late postoperative complications.**

| Complication | No. of patients | Early/late |
|---|---|---|
| haemothorax | 1 | early |
| Horner's – transient | 1 | early |
| pain/paraesthesia | 3 | late |

**Table 2. Range of SSRs in 26 patients following thoracoscopic sympathectomy.**

| Amplitude of SSR (uV) | No. of limbs |
|---|---|
| ABSENT | 7 |
| >0–500 | 12 |
| 500–1000 | 15 |
| 1000–1500 | 11 |
| 1500–2000 | 4 |
| >2000 | 3 |

and of these 26 (72%) attended for follow-up. All patients had undergone bilateral sympathectomies. One was performed as a staged procedure, the remainder undertaken during the same anaesthetic. Twenty-one patients were female. Mean (range) age at operation was 23 (9–36) years. Hyperhidrosis affected the hands in 15 cases, the axillae in five cases and both in six cases.

Early postoperative complications occurred in two patients (Table 1). Mean (range) follow-up was 39 (4–138) months. Late complications, discovered on follow-up occurred in three patients (Table 1). Mean (range) hospital stay was 2 (1–6) days.

### *Patient satisfaction*

In 92% of patients symptoms were reported as severe preoperatively. Only two cases described their symptom as moderate. At follow-up 88% reported symptoms as abolished or only mild and, in the remaining three patients, sympathectomy had successfully controlled symptoms unilaterally. One of these patients was completely asymptomatic for the first 6 weeks after surgery but developed recurrent sweating on one palm. Median (range) patient satisfaction on visual analogue assessment was 0.83 (0.06–1).

### *Sympathetic skin responses*

The range of SSRs are shown in Table 2. Only seven palms had completely absent SSRs. Time since surgery did not account for a significant proportion of the variance in SSR amplitude between patients ($F=0.48$, degrees of freedom 1 and 21, $p=0.49$). Repeated measurements of analysis of variance (ANOVA) showed compensatory sweating to be of low significance with respect to SSR amplitude ($F=2.38$, degrees of freedom 1, $p=0.14$). Adjusting analysis for age and sex did not alter the results. There was no correlation between patient satisfaction and amplitude of SSR (Figure 3).

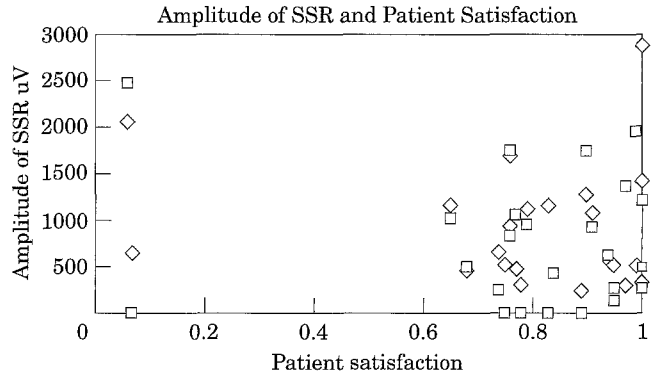


**Fig. 3.** Scattergram of patient satisfaction assessed by visual analogue score and amplitude of SSR. (◇) R amp, (□) L amp.

## Discussion

Telford, one of the pioneers of sympathectomy, is quoted as saying 'I do not think that any operator who has sufficient experience of sympathectomy and followed up his patients for some years can regard the outcome of his work as entirely satisfactory'.[34] As with many surgical techniques, objective measures of outcome are difficult to define or quantify. It has been suggested that measurement of SSRs may be useful as a tool to quantify the success of thoracoscopic sympathectomy.[33] Our present findings contradict this proposal. This study demonstrates that endosomatic electrodermal activity may return after thoracoscopic sympathectomy, but does not correlate with recurrence of symptoms of excessive sweating.

Sympathetic nerve regeneration has been proposed,[17] and one case of complete regeneration of the sympathetic chain has been demonstrated histologically.[35] This is a potential mechanism by which electrodermal activity may return. An alternative explanation is that neural plasticity facilitates recruitment of alternative pathways. One further possibility is that surgical sympathectomy, in which a segment of the chain is excised and the nerve of Kuntz divided, does not permanently ablate the entire sympathetic pathway.

In this study there was no significant association between SSR amplitude and time since surgery or

incidence of compensatory sweating. However, outcome, judged by a high level of patient satisfaction on long-term review following thoracoscopic sympathectomy, was satisfactory.

SSRs may prove to be a useful tool for investigation of the behaviour of sympathetic activity following sympathectomy for other conditions such as Raynaud's disease, where recurrence of vasospastic symptoms often occurs in the long term. More work is needed in this area to investigate sympathetic dysfunction using microneurographic techniques. Such studies may eventually address problems that at present allow sympathectomy only limited success in the treatment of conditions other than hyperhidrosis.

This study has demonstrated that amplitude of SSR is not related to time since surgery or occurrence of compensatory sweating. Return of SSR does not correlate with recurrence of symptoms following thoracoscopic sympathectomy for hyperhidrosis and as such is a poor indicator of clinical outcome. With careful patient selection thoracoscopic sympathectomy has excellent long-term results with high patient satisfaction in the treatment of primary hyperhidrosis.

*Acknowledgements*

The authors are grateful to Dr B. Reeves and Miss C. Swinburn for their help and advice regarding statistical analysis and to Mr G. James for his artistic skill. Mr David R. Lewis is funded by a research grant from The Royal College of Surgeons of England.

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*Accepted 9 October 1997*